



Organizing the voice questionnaire for transgender persons

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ABSTRACT

Background: The validated Transsexual Voice Questionnaire Male to Female (TVQ^{MtF}) and the adapted TVQ Female to Male (FtM) (TVQ^{FtM}) are both 30-item-long questionnaires used to evaluate self-perception of voice in transgender persons. They are part of a series of questionnaires completed by transgender persons during follow-up of cross-sex hormone therapy (CSHT).

Aim: The aim of this study was to examine if these questionnaires can be organized.

Methods: The TVQ^{MtF} or the TVQ^{FtM} was filled out at the start of CSHT, by 145 trans women and 83 trans men. Data were analyzed by factor analyses on both the questionnaires.

Results: The factor analyses resulted in a three-factor solution for both the TVQ^{MtF} and the TVQ^{FtM}. The three factors were labeled as anxiety and avoidance, vocal identity, and vocal function.

Conclusion: Both the questionnaires can be organized into three factors. This could contribute to making shorter versions of the questionnaires. Shorter versions would be useful to hormone prescribing physicians to track down more quickly voice problems in trans people undergoing virilizing or feminizing hormone treatment.

KEYWORDS

ENIGI; questionnaire; self-perception; transgender; voice

Introduction

Self-perception of how the voice impacts on a person is important and there is little research on the standard measures available for transgender persons (Hancock, 2017; Wierckx et al., 2011). The Transsexual Voice Questionnaire Male to Female (TVQ^{MtF}) is a validated questionnaire often suggested to assess self-perception of voice in trans women. It is a patient reported outcome measure (Dacakis, Davies, Oates, Douglas, & Johnston, 2013; Dacakis, Oates, & Douglas, 2016a; Davies & Johnston, 2015). The TVQ^{MtF} evolved from an extensive review of the Transgender Self-Evaluation Questionnaire (TSEQ). The TSEQ on its own was developed from the Voice Handicap Index (VHI), a widely used questionnaire to quantify physical, emotional, and functional consequences of voice disorders (Jacobson et al., 1997), to be trans-specific (Dacakis et al., 2013). The authors of the TVQ^{MtF} determined that its predecessor, the TSEQ, which

was universal, was inadequate partially because it was not specific enough for a population. Therefore, they created a trans female-specific version of the TSEQ: the TVQ^{MtF} (Dacakis et al., 2013). As of yet, no version of the self-perception of voice questionnaire has been developed for trans men. However, evaluating self-perception of voice in trans men is also important (Davies & Goldberg, 2006; Davies, Papp, & Antoni, 2015). Therefore, besides the validated TVQ^{MtF}, an adapted version is also used for clinical follow-up and research in the ENIGI (European Network for the Investigation of Gender Incongruence; see Kreukels et al., 2012) study: the Transsexual Voice Questionnaire Female to Male (TVQ^{FtM}). In this adapted TVQ^{FtM} only, the gender-specific words have been modified. The lengthy validated TVQ^{MtF} and the nonvalidated and adapted version for trans men (TVQ^{FtM}) consist of 30 statements about voice. A four-point Likert scale is applied with following response options:

1 = never or rarely, 2 = sometimes, 3 = often, and 4 = usually or always (Dacakis et al., 2013).

The TVQ^{MtF} and the TVQ^{FtM} are part of a series of questionnaires (about dermatology, life-style, fertility, insomnia, physical symptoms, etc.) used during cross-sex hormone therapy (CSHT) follow-up examining effects and side-effects of treatment. More user-friendly and concise versions of the TVQ^{MtF} and the TVQ^{FtM} can be beneficial and time efficient. Studying if the TVQ^{MtF} and the TVQ^{FtM} can be subdivided into factors contributes in improving user-friendliness of these questionnaires.

Organizing the questionnaire

It has been demonstrated that the VHI, a predecessor of the TVQ, can be divided into three subscales covering the areas of functional, emotional, and physical aspects of voice disorders (Jacobson et al., 1997). Furthermore, Dacakis, Oates, and Douglas (2016b) found that two components (i.e., vocal functioning and social participation) can be identified in the TVQ^{MtF}. These findings support the clinical utility of organizing the questionnaire. In the latter study of Dacakis et al., it was discussed that the first component “vocal functioning” contained eight questions about voice production and five questions about the association between voice and gender identity. The second component “social participation” contained questions about avoidance or restriction in social participation and about a negative emotional response to voice that could conceivably impact the individual’s social participation (Dacakis et al., 2016b).

Known effects of cross-sex hormone therapy on the voice

For trans men, it is known that there are different patterns of voice deepening during CSHT. The first 3 months of CSHT may result in an improving self-perception of voice and in a lower pitched voice. Between 3 and 6, between 6 and 9, and between 6 and 12 months of CSHT, further voice deepening may occur. Some trans men (6 of 50 participants in the study of Nygren, Nordenskjöld, Arver, & Södersten, 2016) still

show a high fundamental frequency after 12 months of CSHT (Bultynck et al., 2017; Hancock, Childs, & Irwig, 2017; Irwig, Childs, & Hancock, 2017; Nygren et al., 2016). For trans women, self-perception of voice improves between 0–3 and between 0–12 months of CSHT follow-up. This improvement is not associated with CSHT: in trans women who already went through male puberty, testosterone has irreversibly virilized the voice before the CSHT is commenced (Bultynck et al., 2017).

Materials and methods

This follow-up study from March 2010 until November 2015 was part of the ENIGI. ENIGI was created to obtain more transparency in diagnostics and treatment of gender dysphoria (Dekker et al., 2016; Kreukels et al., 2012). The protocol of this follow-up study was approved by the Ethics Committee of the Ghent University Hospital, Belgium. At the start of the research, all participants gave their written informed consent.

Participants

Transgender persons presenting at the Ghent University Hospital in Belgium, for follow-up during CSHT, were invited to participate in the ENIGI study. If they were willing to participate, they signed an informed consent. Participants completed the TVQ^{MtF} or the TVQ^{FtM}. A factor analysis was conducted on data obtained at the start (145 trans women and 83 trans men) of the CSHT follow-up. Trans men included at baseline were between 17 and 47 years old (mean = 25.60, SD = 7.996). Trans women included at baseline were between 16 and 69 years old (mean = 32.81, SD = 13.018). Persons undergoing voice therapy or voice surgery at baseline were not excluded in this study. It was assumed that undergoing voice therapy or voice surgery would not have an impact on the results of the factor analyses.

Questionnaire

The adapted TVQ^{FtM} is very similar to the validated TVQ^{MtF}; only the gender-specific words are different. An author-approved Dutch version

Table 1. Descriptive statistics of the principal factor analysis in trans women.

Item	Baseline	
	Mean	SD
1. People have difficulty hearing me in a noisy room.	2.07	1.011
2. I feel anxious when I know I have to use my voice.	1.93	0.933
3. My voice makes me feel less feminine than I would like.	3.06	0.952
4. The pitch of my speaking voice is too low.	2.86	1.078
5. The pitch of my voice is unreliable.	2.28	0.955
6. My voice gets in the way of me living as a woman.	2.24	1.156
7. I avoid using the phone because of my voice.	1.56	0.949
8. I'm tense when talking with others because of my voice.	1.89	0.944
9. I get hoarse when I try to speak with my female voice.	1.87	0.892
10. My voice makes it hard for me to be identified as a woman.	2.52	1.093
11. When I speak the pitch of my voice does not vary enough.	2.19	1.023
12. I feel uncomfortable talking to friends, neighbors, and relatives because of my voice.	1.57	0.848
13. I avoid speaking in public because of my voice.	2.03	1.089
14. My voice sounds artificial.	1.81	0.923
15. I have to concentrate to make my voice sound the way I want it to sound.	2.56	1.086
16. I feel frustrated with trying to change my voice.	2.16	1.084
17. My voice difficulties restrict my social life.	1.68	0.957
18. When I'm not paying attention, the tone of my voice gets lower.	2.40	1.043
19. When I laugh I sound like a man.	2.68	1.117
20. My voice doesn't match my physical appearance.	2.47	1.112
21. I use a great deal of effort to produce my voice.	2.07	0.976
22. My voice gets tired quickly.	1.89	0.965
23. My voice restricts the sort of work I do.	1.52	0.980
24. I feel my voice does not reflect the "true me."	2.71	1.118
25. I am less outgoing because of my voice.	1.43	0.823
26. I feel self-conscious about how strangers perceive my voice.	2.23	1.098
27. My voice "gives out" in the middle of speaking.	1.34	0.648
28. It distresses me when I'm perceived as a man because of my voice.	2.23	1.177
29. The pitch range of my speaking voice is restricted.	2.04	0.978
30. I feel discriminated against because of my voice.	1.49	0.746

Note. Mean \pm standard deviation (SD). $N = 145$. The lower the score (width 1–4), the more satisfied the trans woman is about the perception of her voice. 1 = never or rarely, 2 = sometimes, 3 = often, and 4 = usually or always.

of the validated TVQ^{MtF} exists. The adapted TVQ^{FtM} was translated into Dutch for the participants of the study, but is not validated.

Statistical analysis

To verify whether the TVQ^{MtF} and TVQ^{FtM} can be organized in different factors, a factor analysis was performed.

A factor analysis is a statistical technique that reduces a large number of interrelated questions to a smaller number of underlying common factors (Harper, Kim, & Mueller, 1980). Four sequential steps were followed at each of the three different test moments. The first step involved the identification of the number of meaningful factors to retain. This was based on the interpretation of the scree plot and the percentage of variance accounted for by a given factor. The second step comprised the analysis of the rotated factor matrix to identify the questions loading on the factors determined in step 1. It was stated that each obtained factor must include

at least three questions to be a reliable factor. Pattern loadings near 0.40 or greater (in absolute value) were used to interpret the results. The third step consisted of the determination of the reliability of each factor. Cronbach's alpha reliability coefficients (≥ 0.700) were computed to measure the internal consistency of each factor. The fourth step included labeling the different factors and checking if the content of the questions within one factor was similar.

Results

The descriptive statistics of the principal factor analysis in trans women and trans men are shown in Tables 1 and 2, respectively. The rotated factor matrices in trans women and trans men are shown in Tables 3 and 4, respectively.

Defining the number of factors

Three factors could be withheld in both the questionnaires. Cronbach's alpha were always > 0.700 (Table 5).

Table 2. Descriptive statistics of the principal factor analysis in trans men.

Item	Baseline	
	Mean	SD
1. People have difficulty hearing me in a noisy room.	1.87	1.021
2. I feel anxious when I know I have to use my voice.	1.93	0.934
3. My voice makes me feel less masculine than I would like.	2.84	0.994
4. The pitch of my speaking voice is too high.	2.6	1.07
5. The pitch of my voice is unreliable.	1.67	0.925
6. My voice gets in the way of me living as a man.	2.7	1.112
7. I avoid using the phone because of my voice.	1.9	1.089
8. I'm tense when talking with others because of my voice.	1.84	1.042
9. I get hoarse when I try to speak with my male voice.	1.51	0.817
10. My voice makes it hard for me to be identified as a man.	2.54	1.151
11. When I speak the pitch of my voice does not vary enough.	1.65	0.788
12. I feel uncomfortable talking to friends, neighbors, and relatives because of my voice.	1.65	0.93
13. I avoid speaking in public because of my voice.	2.05	1.125
14. My voice sounds artificial.	1.45	0.785
15. I have to concentrate to make my voice sound the way I want it to sound.	1.8	1.079
16. I feel frustrated with trying to change my voice.	1.84	1.131
17. My voice difficulties restrict my social life.	1.72	0.979
18. When I'm not paying attention, the tone of my voice gets higher.	1.86	1.049
19. When I laugh I sound like a woman.	2.71	1.143
20. My voice doesn't match my physical appearance.	2.67	1.116
21. I use a great deal of effort to produce my voice.	1.61	0.922
22. My voice gets tired quickly.	1.47	0.786
23. My voice restricts the sort of work I do.	1.51	0.955
24. I feel my voice does not reflect the "true me."	2.8	1.197
25. I am less outgoing because of my voice.	1.42	0.798
26. I feel self-conscious about how strangers perceive my voice.	2.05	1.103
27. My voice "gives out" in the middle of speaking.	1.31	0.661
28. It distresses me when I'm perceived as a woman because of my voice.	2.6	1.209
29. The pitch range of my speaking voice is restricted.	1.61	0.824
30. I feel discriminated against because of my voice.	1.47	0.801

Note. Mean \pm standard deviation (SD). $N=83$. The lower the score (width 1–4), the more satisfied the trans man is about the perception of his voice. 1 = never or rarely, 2 = sometimes, 3 = often, and 4 = usually or always.

Interpretation and labeling of the factors

The three obtained factors for both the questionnaires were interpreted and labeled commonly. A remarkable question overlap of corresponding factors in the questionnaires for trans women and trans men was observed.

Factor 1: Anxiety and avoidance

The first factor was composed of questions about feeling anxious or uncomfortable, being restricted in social life or in type of work because of the voice. Therefore, factor 1 was labeled "anxiety and avoidance." Based on the absolute values loading in the rotated factor matrix and the content of the questions, "anxiety and avoidance" incorporated 11 questions (i.e., 2, 7, 8, 12, 13, 16, 17, 23, 25, 26, and 30) and had minimum and maximum scores of 11 and 44, respectively. The recalculated Cronbach's alpha values were 0.877 for the TVQ^{MtF} and 0.935 for the TVQ^{FtM}.

Factor 2: Vocal identity

The second factor encompassed questions about feeling less masculine/feminine than desired,

because of the voice and the incongruence between appearance and voice. Therefore, factor 2 was labeled "vocal identity." Based on the absolute values loading in the rotated factor matrix and the content of the questions, "vocal identity" consisted of eight questions (i.e., 3, 4, 6, 10, 19, 20, 24, and 28) with minimum and maximum scores of 8 and 32, respectively. The recalculated Cronbach's alpha values were 0.864 for the TVQ^{MtF} and 0.912 for the TVQ^{FtM} at baseline.

Factor 3: Vocal function

The third factor enclosed questions regarding voice characteristics. Factor 3 was labeled "vocal function" and included 11 questions (i.e., 1, 5, 9, 11, 14, 15, 18, 21, 22, 27, and 29), with a score ranging from 11 to 44. The recalculated Cronbach's alpha values were 0.849 for the TVQ^{MtF} and 0.868 for the TVQ^{FtM}.

Discussion

The TVQ^{MtF} and the TVQ^{FtM} are 30-item-long questionnaires used to evaluate self-perception of

Table 3. Rotated factor matrix in trans women.

Items	F1	F2	F3
1. Anxiety and avoidance			
2. I feel anxious when I know I have to use my voice.	0.48		
7. I avoid using the phone because of my voice.			
8. I'm tense when talking with others because of my voice.			
12. I feel uncomfortable talking to friends, neighbors, and relatives because of my voice.	0.63		
13. I avoid speaking in public because of my voice.	0.51		
16. I feel frustrated with trying to change my voice.		0.41	0.52
17. My voice difficulties restrict my social life.	0.70		
23. My voice restricts the sort of work I do.	0.55		
25. I am less outgoing because of my voice.	0.62		
26. I feel self-conscious about how strangers perceive my voice.			
30. I feel discriminated against because of my voice.			
2. Vocal identity			
3. My voice makes me feel less feminine than I would like.		0.71	
4. The pitch of my speaking voice is too low.		0.68	
6. My voice gets in the way of me living as a woman.		0.56	
10. My voice makes it hard for me to be identified as a woman.		0.71	
19. When I laugh I sound like a man.		0.65	
20. My voice doesn't match my physical appearance.		0.48	
24. I feel my voice does not reflect the "true me."		0.74	
28. It distresses me when I'm perceived as a man because of my voice.			
3. Vocal function			
1. People have difficulty hearing me in a noisy room.			
5. The pitch of my voice is unreliable.			0.58
9. My voice gets croaky, hoarse, or husky when I try to speak in a female voice			0.58
11. When I speak the pitch of my voice does not vary enough.			0.40
14. My voice sounds artificial.			0.52
15. I have to concentrate to make my voice sound the way I want it to sound.		0.42	0.64
18. When I am not paying attention my pitch goes down.		0.43	0.55
21. I use a great deal of effort to produce my voice.			0.66
22. My voice gets tired quickly.			0.69
27. My voice "gives out" in the middle of speaking.			
29. The pitch range of my speaking voice is restricted.			0.43

Note. $N = 145$. Pattern loadings < 0.40 were not shown in the rotated factor matrix. F1 = Factor 1 "Anxiety and avoidance," F2 = Factor 2 "Vocal identity," and F3 = Factor 3 "Vocal function."

voice in trans women and trans men. They are currently part of a series of questionnaires used during (CSHT) follow-up in the ENIGI study. Organizing the TVQ^{MtF} and the TVQ^{FtM} into different factors can contribute to creating more user-friendly and more concise versions of the questionnaires. This leads to a better patient experience as the questionnaires may be long if a one has to fill out a number of other questionnaires, such as in the ENIGI study.

In this study, the results of conducted factor analyses showed there was a remarkable question overlap of corresponding factors of the TVQ^{MtF} and the TVQ^{FtM}. Therefore, three common factors composed of the same questions were retained in the TVQ^{MtF} and TVQ^{FtM}: "anxiety and avoidance," "vocal identity," and "vocal function."

The principal components analysis of Dacakis et al. (2016b) identified a two-component structure in the TVQ^{MtF}: "vocal functioning" and "social participation." Dacakis et al. (2016b) discussed that the first component "vocal

functioning" contained eight questions about voice production, which are similar to the questions belonging to the factor "vocal function" of this study; and five questions about the link between voice production and gender identity, which are similar to the questions belonging to the factor "vocal identity" of this study. The second component "social participation" contained questions about avoidance or restriction in social participation and about a negative emotional response to voice that could conceivably impact on the individual's social participation. This second component is quite similar to the factor "anxiety and avoidance" of this study (Dacakis et al., 2016b). In Table 6, a comparison between the results of the component analysis of Dacakis et al. (2016b) and the factor analyses of this study is shown. There are similarities between the following:

1. the factor "vocal function" and the voice production part of the first component "vocal

Table 4. Rotated factor matrix in trans men.

Items	F1	F2	F3
1. Anxiety and avoidance			
2. I feel anxious when I know I have to use my voice.	0.66		
7. I avoid using the telephone because of my voice.	0.52		
8. I get tense when talking to others because of my voice.	0.64	0.40	
12. I feel uncomfortable talking with friends, neighbors, or relatives because of my voice.	0.56		
13. I avoid speaking in public because of my voice.	0.54		
16. I feel frustrated when I try to change my voice.	0.56	0.42	
17. My difficulties with my voice restrict my social life.	0.80		
23. My voice restricts the type of work I do.	0.67		
25. I come out less because of my voice.	0.73		
26. I am aware of how strangers perceive my voice.	0.62	0.43	
30. I feel discriminated against because of my voice.	0.59	0.41	
2. Vocal identity			
3. My voice makes me feel less masculine than I would like.		0.76	
4. The tone of my speaking voice is very high.		0.73	
6. My voice disrupts my life as a man.		0.69	
10. My voice makes it difficult for me to be recognized as a man.		0.80	
19. When I laugh, I sound like a woman.		0.70	
20. My voice does not suit my physical appearance.		0.65	
24. I feel that my voice does not reflect my "true self."		0.79	
28. I get annoyed when I am perceived as a woman because of my voice.	0.46	0.50	0.46
3. Vocal function			
1. People have difficulty hearing me in a noisy room.			0.52
5. It's hard to know how the tone of my voice will sound.			0.46
9. I get hoarse when I try to speak with my male voice.			0.54
11. The tonal range of my male voice is small.			0.44
14. My voice sounds artificial.			
15. I have to concentrate to make my voice sound like I want it to sound.			
18. When I am not paying attention my pitch goes up.			
21. I have to make a huge effort to produce my voice.	0.41		0.54
22. My voice gets tired quickly.			0.76
27. My voice "breaks up" in the middle of speech.			0.80
29. My speaking voice has a small variation of tones.			0.46

Note. $N = 83$. Pattern loadings < 0.40 were not shown in the rotated factor matrix. F1 = Factor 1 "Anxiety and avoidance," F2 = Factor 2 "Vocal identity," and F3 = Factor 3 "Vocal function."

Table 5. Results of the factor percentages of variance, Cronbach's alpha values, and question numbers per factor are shown. The three factors could be withheld in trans men and trans women.

Baseline				
Trans men		Factor 1	Factor 2	Factor 3
Variance (%)		20	18	12
Cronbach's alpha		0.935	0.912	0.853
Question numbers		2, 7, 8, 12, 13, 16, 17, 23, 25, 26, 30	3, 4, 6, 10, 19, 20, 24, 28	5, 9, 11, 14, 21, 22, 27, 29
Trans women		Factor 1	Factor 2	Factor 3
Variance (%)		11	15	13
Cronbach's alpha		0.840	0.872	0.887
Question numbers		2, 12, 13, 17, 23, 25	3, 4, 6, 10, 11, 19, 20, 24	1, 7, 8, 26, 28, 30

functioning" (e.g., *The pitch of my voice is unreliable.*);

- the factor "gender identification" and the part about the link between voice production and gender identity of the first component "vocal functioning" (e.g., *My voice makes me feel less feminine than I would like.*);
- the factor "anxiety and avoidance" and the second component "social participation" (e.g., *I feel anxious when I know I have to use my voice.*).

The strengths of this study are that a factor analysis was run on the adapted TVQ^{FtM} and, the

research was based on data gathered from the largest study population of trans men for voice evaluation with this adapted questionnaire to date. The study also includes limitations, which consist of the use of a not yet validated voice questionnaire trans men. This questionnaire for trans men was based on the questionnaire for trans women, but some items (e.g., items 11 and 16) appear less relevant in trans men. Trans men seem to experience more diverse gender-related voice problems than trans women (Azul, 2015; Azul, Arnold, & Neuschaefer-Rube, 2018; Azul, Nygren, Södersten, & Neuschaefer-Rube, 2017).

Table 6. Comparison of the results of factor analyses of this study to the results of the component analysis of the TVQ^{MtF} by Dacakis et al.

Result of the factor analyses of the current study		Result of the component analysis of Dacakis et al.
ANXIETY AND AVOIDANCE		SOCIAL PARTICIPATION
2. I feel anxious when I know I have to use my voice.	®	1. People have difficulty hearing me in a noisy room.
7. I avoid using the phone because of my voice.	®	2. I feel anxious when I know I have to use my voice.
8. I'm tense when talking with others because of my voice.	®	6. My voice gets in the way of me living as a woman.
12. I feel uncomfortable talking to friends, neighbors, and relatives because of my voice.	®	7. I avoid using the phone because of my voice.
13. I avoid speaking in public because of my voice.	®	8. I'm tense when talking with others because of my voice.
16. I feel frustrated with trying to change my voice.		12. I feel uncomfortable talking to friends, neighbors, and relatives because of my voice.
17. My voice difficulties restrict my social life.	®	13. I avoid speaking in public because of my voice.
23. My voice restricts the sort of work I do.	®	14. My voice sounds artificial.
25. I am less outgoing because of my voice.	®	17. My voice difficulties restrict my social life.
26. I feel self-conscious about how strangers perceive my voice.		23. My voice restricts the sort of work I do.
30. I feel discriminated against because of my voice.	®	25. I am less outgoing because of my voice.
VOCAL IDENTITY		VOCAL FUNCTIONING
3. My voice makes me feel less feminine than I would like.	®	Link between voice and gender identity
4. The pitch of my speaking voice is too low.	®	3. My voice makes me feel less feminine than I would like.
6. My voice gets in the way of me living as a woman.		4. The pitch of my speaking voice is too low.
10. My voice makes it hard for me to be identified as a woman.	®	10. My voice makes it hard for me to be identified as a woman.
19. When I laugh I sound like a man.	®	19. When I laugh I sound like a man.
20. My voice doesn't match my physical appearance.	®	20. My voice doesn't match my physical appearance.
24. I feel my voice does not reflect the "true me."	®	24. I feel my voice does not reflect the "true me."
28. It distresses me when I'm perceived as a man because of my voice.		
VOCAL FUNCTION		Voice production
1. People have difficulty hearing me in a noisy room.		5. The pitch of my voice is unreliable.
5. The pitch of my voice is unreliable.	®	9. My voice gets croaky, hoarse or husky when I try to speak in a female voice
9. My voice gets croaky, hoarse or husky when I try to speak in a female voice	®	11. When I speak the pitch of my voice does not vary enough.
11. When I speak the pitch of my voice does not vary enough.	®	15. I have to concentrate to make my voice sound the way I want it to sound.
14. My voice sounds artificial.		16. I feel frustrated with trying to change my voice.
15. I have to concentrate to make my voice sound the way I want it to sound.	®	18. When I am not paying attention my pitch goes down.
18. When I am not paying attention my pitch goes down.	®	21. I use a great deal of effort to produce my voice.
21. I use a great deal of effort to produce my voice.	®	
22. My voice gets tired quickly.		
27. My voice "gives out" in the middle of speaking.		
29. The pitch range of my speaking voice is restricted.	®	29. The pitch range of my speaking voice is restricted.
		NO COMPONENT
		22. My voice gets tired quickly.
		26. I feel self-conscious about how strangers perceive my voice.
		27. My voice "gives out" in the middle of speaking.
		28. It distresses me when I'm perceived as a man because of my voice.

Note. The three factors and their questions found in this study are shown in the left column. In the right column, the two components of the analysis of Dacakis et al. are shown. The component "vocal functioning" of Dacakis et al. contains questions about voice production and about the link between voice and gender identity. Questions belonging to no component of the study of Dacakis et al. are also shown. Questions in bold and connected by an arrow correspond to a similar factor and component in both the studies.

In future, offering more specific items for virilizing or feminizing effects on voice should be considered. Furthermore, in trans women items 15, 16, and 18 of the questionnaire can be more difficult to score early in the process of CSHT, if a binary social gender role has not been initiated.

Also a small proportion of the reliability of the factors was lost by defining three identical factors for both trans women and trans men after the

analyses. This resulted in a slight decrease in Cronbach's alpha values. The TVQ^{MtF} and the adapted TVQ^{FtM} do not reflect all current terminology and individual needs. The title of the TVQ^{MtF}, for example, reflects outdated heterocis-normative binary terminology, and highlights the need for further (linguistic) adaptation and improvement of these questionnaires as clinically helpful tools.

Based on the results of the factor analyses of this study and the previous component analysis of the TVQ^{MtF} (Dacakis et al., 2016b), further research should focus on creating a shorter version of the TVQ for trans women and trans men. A reduction of the number of questions within each factor or component would result in the creation of more user-friendly versions of the TVQ's when an explorative evaluation of voice is desired, as in the ENIGI study.

Also, organizing the TVQ^{MtF} and the TVQ^{FtM} into factors provides quick, useful information and insight for a voice training process. Is the patient more anxious and socially isolating himself/herself (anxiety and avoidance)? Is the problem rather due to a discrepancy between the voice and the desired sex (vocal identity)? Or does the trans person experience problems with voice quality (voice quality)?

This study provides a straightforward contribution to the question whether it is possible to organize the TVQ for trans women and trans men into factors. The factor analyses gave rise to the division of the TVQ^{MtF} and the TVQ^{FtM} into the three same factors: "anxiety and avoidance," "vocal identity," and "vocal function." A shorter version of the questionnaires would be useful to hormone prescribing physicians to track down voice problems in trans people undergoing virilizing or feminizing hormone treatment more quickly.

Declaration of statement of interest

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